DATA SHEET

MD-6002

USB2.0 Flash Disk Controller

Revision 1.3

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1. General Description

MD6002 is a high-performance integrated circuit to access the Data Flash memory via the 480 MHz USB 2.0 bus. It provides a flexible and cost efficient single chip solution for external storage applications such as USB Disk (Flash Disk) and fingerprint interface. With all the features inherited from the popular MD6001, the users can easily upgrade to **MD6002** and enjoy the tremendous speed increment.

Although the USB speed is increased 40 times from 12 M to 480 M, the external crystal frequency of **MD6002** is still kept at 12MHz, keeping the EMI at low level. The functions that ensure the data integrity like the embedded translation table, the MoreDNA proprietary randomization algorithm, and the real time ECC correction function are all the implemented as the USB 1.1 version. **MD6002** also incorporates MoreDNA in-house algorithm to improve the performance of the flash disk.

To enrich the product line of the OEM manufacture and reduce the effort of component sourcing, **MD6002** supports both single channel and dual channel modes in a single chip. In addition, **MD6002** supports NAND flash memories of Samsung, Toshiba, Hynix, STMicroelectronics , Micron and, providing more flexibility for the flash memory's purchasing and Toshiba/ Hynix MLC flash memories.

With the ability to support 8 pieces of flash memories and the new types of 2Gb, 4Gb, 8Gb, 16Gb and 32Gb bits flashes, **MD6002** can be used to build up a storage device up to 16 Giga bytes large.

The USB Mass Storage Class compliance capability of **MD6002** makes it a truly "plug-and-play" device without vendor drivers under Windows Vista/2000/ME/XP and WIN-CE, Mac OS 8.6/9/10, and Linux. **MD6002** also provides PC boot up function as a USB ZIP, USB HDD or USB CD-ROM, which makes it an ideal replacement for the legacy floppy disk.

2. Features

- USB 2.0 480 MHz high-speed compatible
- USB 1.1 Mass Storage Class compliant
- USB Mass Storage Class Bulk-Only Transport 1.0 supported
- USB Mass Storage Class SCSI transparent command set supported
- Low system clock (12MHz) to reduce EMI
- Customized USB VID, PID, serial number, and USB vendor/product strings
- 28 characters of Vendor/Product/Revision string supported for each LUN separately
- Support Samsung and Toshiba NAND-type flash memory, from 32Mbits to 1Gbits
- Support new type of Samsung NAND type flash memory, from 1Gbits to 32Gbits
- Support Hynix /STMicroelectronics/Micron flash memories
- Support Toshiba / Samsung /Hynix MLC flash memories
- Support ZIP/HDD/CD-ROM format through MoreDNA mass production tool
- Support Autorun function (Optional)
- Support CD-RW function (Optional)
- Real-time ECC correction circuit for data integrity and memory access speed acceleration
- Embedded SRAM for logical-to-physical address translation to extend the life time of NAND-type flash
- Support up to 8 NAND type flash memories are supported (single channel mode)
- Support dual channel mode for speed improvement
- Support up to 16G bytes of disk capacity
- Embedded FIFO for upstream and downstream data transfer
- Built-in power MOS to meet USB suspend requirement (500 uA)
- Data transfer rate up to 60MB/s (burst)
- LED indicator pin
- Three modes of LED flashing patterns can be selected
- Five speed of LED flashing speed provided
- PC boot up capability (host BIOS with USB boot up support is necessary)
- Flash disk security function provided, up to 16 characters of password for high sensitive data protection from illegally access
- Most security features can be accessed by the administrator mode and the user mode under Microsoft Windows. (Optional)

- Five types of security functions can be selected
- Ten types of sensor can be selected
- ROM-type flash disk capability provided (permanent write protect)
- Different LUN can be set to write protect separately
- No driver needed under Microsoft Windows Vista/ME/2000/XP, Mac OS 8.6/9.x/10.xNo driver needed for Linux kernel 2.4 or above
- MoreDNA Driver for Microsoft Windows 98/98SE
- MoreDNA mass production tool available for mass production (under win2k/xp)
- MoreDNA utility program available (under Windows and Mac 10.2 or above)
- MoreDNA driver and utility program available (under Mac 9, version 9.1 or above)
- Signal Voltage 3.3V operation (input)
- 64 pin LQFP package

3. Pin Assignment

Table 1 MD-6002 pin list

NO	pin name	type	description
1	VDD33	PWR	Digital 3.3V
2	LED	DO	LED output
3	GPIO4	DIO	General purpose input/output 4
4	INT	DI	External Interrupt input
5	GPO5(F_CE5)	DO	General purpose output 5/ flash chip enable 5
6	VDDA	PWR	Analog 3.3V
7	RPU	AIO	Connect to 1.5K pull up resistor
8	DPLUS	AIO	USB D+
9	DMINUS	AIO	USB D-
10	VSSA	PWR	Analog ground
11	VDD33	PWR	Digital 3.3V
12	VDD18	PWR	Digital 1.8V
13	VSSD	PWR	Digital ground
14	VDDA	PWR	Analog 3.3V
15	VSSA	PWR	Analog ground
16	VRES	AIO	Reference voltage, connect to 6.2K resistor
17	FLD15	DIO	Flash data 15
18	FLD0	DIO	Flash data 0
19	FLD1	DIO	Flash data 1
20	XOUT	DO	Crystal output
21	XIN	DI	Crystal input
22	VD33	PWR	Digital 3.3V
23	VD18	PWR	Digital 1.8V
24	VSS	PWR	Digital ground
25	FLWE	DO	Flash write enable
26	FLALE	DO	Flash address latch enable
27	FLD2	DIO	Flash data 2

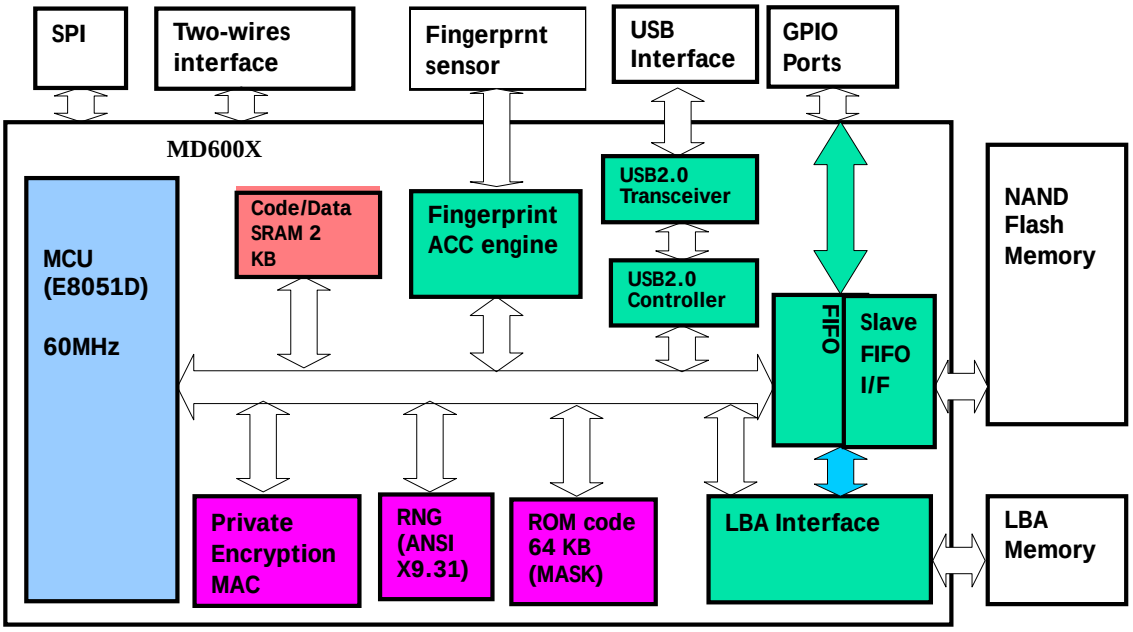
28	GPIO0	DIO	General purpose input/output 0 / flash chip enable (dual channel mode), PU: dual channel mode, PD: single channel mode
29	GPO6(F_CE6)	DO	General purpose output 6/ flash chip enable 6
30	GPO7(F_CE7)	DO	General purpose output 7/ flash chip enable 7
31	VD33	PWR	Digital 3.3V
32	FLCE0	DIO	Flash chip enable 0
33	FLD3	DIO	Flash data 3
34	GPIO5	DIO	General purpose input/output 5
35	FLCE2	DIO	Flash chip enable 2
36	VD33	PWR	Digital 3.3V
37	FLCLE	DO	Flash command latch enable
38	FLD4	DIO	Flash data 4
39	FLD5	DIO	Flash data 5
40	FLD12	DIO	Flash data 12
41	FLD6	DIO	Flash data 6
42	VSS	PWR	Digital ground
43	VD18	PWR	Digital 1.8V
44	VD33	PWR	Digital 3.3V
45	FLRE	DO	Flash read enable
46	FLD13	DIO	Flash data 13
47	FLD7	DIO	Flash data 7
48	FLCE1	DIO	Flash chip enable 1
49	FLD14	DIO	Flash data 14
50	FLCE3	DIO	Flash chip enable 3
51	GPO4(F_CE4)	DO	General purpose output 4/ flash chip enable 4
52	VSS	PWR	Digital ground
53	FLWPSW(GPIO3)	DI	Write protect switch input/ General purpose input /output 3
54	VD33	PWR	Digital 3.3V

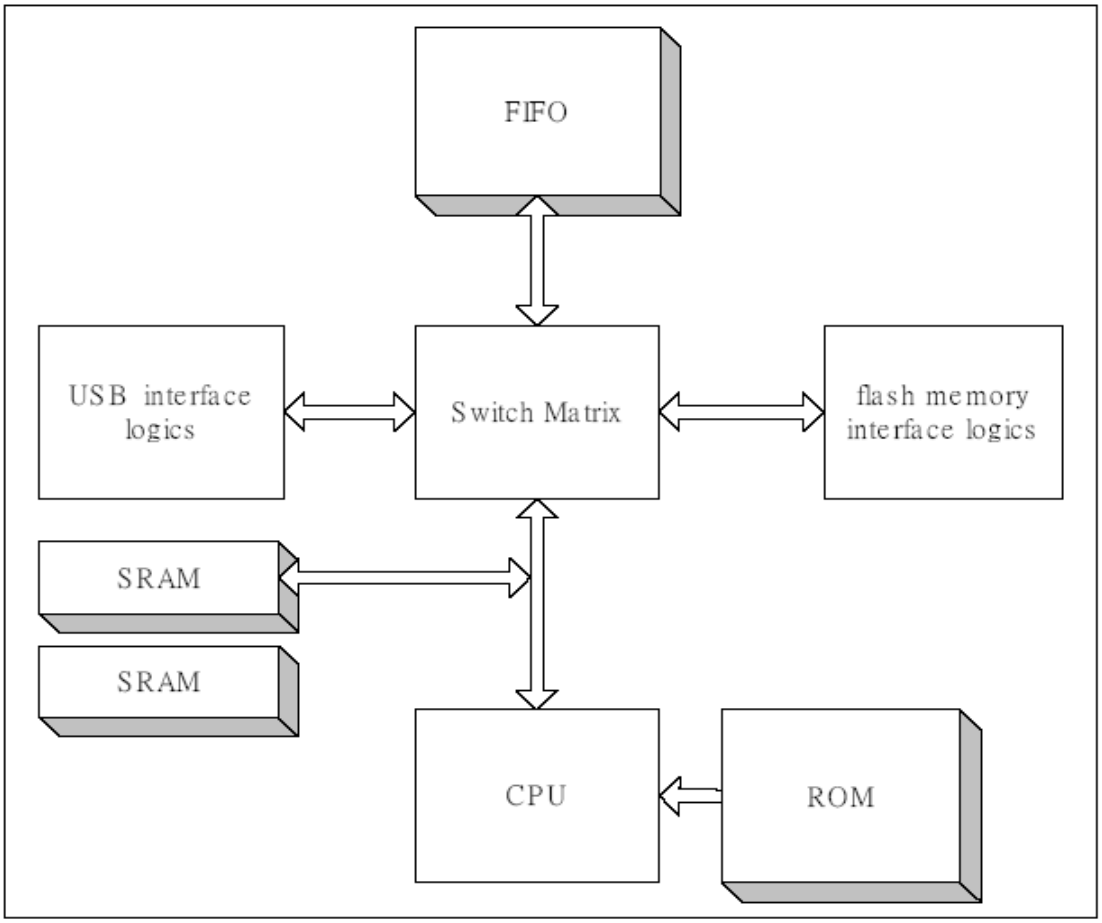
55	RSTN	DI	Chip master reset
56	FLWP	DO	Flash write protect
57	FLRB1	DI	Flash ready/busy
58	FLD8	DIO	Flash data 8
59	FLD9	DIO	Flash data 9
60	FLD10	DIO	Flash data 10
61	FLD11	DIO	Flash data 11
62	VSS	PWR	Digital ground
63	VD18	PWR	Digital 1.8 V
64	VD33	PWR	Digital 3.3V

Note:

1. P：power pin； AI：analog input pin； AIO：analog input/output pin；
   DI：digital input pin； DO：digital output pin； DIO：digital input/output pin.
2. PD：pull down； PU：pull up.
3. All pads are Schmitt triggered and with slew rate control

4. Block Diagram





5. Functional descriptions

5.1 Flash memory connection

In single channel mode, up to 8 NAND type flash memories can be connected to **MD6002** (in dual channel mode, only 2 flash memories can be connected), the number of flash memory connected can be detected automatically upon power on. Each flash memory has its own chip enable control signal path (FLCE 1 to FLCE8). All flash memories connected to **MD6002** must be of the same capacity. There is no special rule for the number of flash memory. (e.g. not necessarily to be the multiples of 2 or 4).

5.2 USB VID/PID/SN and Strings format

The USB vendor ID, product ID, serial number, and the strings can be changed by using the MoreDNA Mass Production tool. The vendor name and product name of each LUN can also be changed. The serial number (defined in mass storage device class) can also be customized or disabled. It should be noted that the VID and PID values cannot be set to 0x0000 or 0xFFFF or any value that reserved by the USB standard. If there is no customized VID/PID, default USB vendor ID (hex 0C45) and product ID (hex 2060) are returned to the host. For detail, please refer to the user's manual of **MD6002** mass production tool.

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5.3 Fingerprint sensor support

The MD6002 can support 7 brand sensor, and 10 kinds sensor.

1. Authentec
2. ATMEL
3. ATRUA
4. LighTuning
5. MITSUMI
6. Pixart
7. SOI

MoreDNA provides the following software to customers.

Please contact the sales for detail.

1) Application software and driver for Win98/2000/Me/XP/Vista; boot up utility is included for Win98/Me
2) Application software and driver for Mac OS9 (version 9.1 or above)*
3) Application software for Mac OS 10.2 or above*
4) Mass production tool under Win2000/XP/Vista
5) Fingerprint Application software for Win98/2000/Me/XP/Vista;

* The functions of the application software between different OS might be different

6. Operating rating and electrical characteristics

6.1 Absolute maximum rating

Table 2

symbol	Parameter	value	unit
Dvmin	min digital supply voltage	DGND – 0.3	V
Dvmax	max digital supply voltage	DGND + 3.6	V
Avmin	min analog supply voltage	AGND – 0.3	V
Avmax	max analog supply voltage	AGND + 3.6	V
Dvinout	voltage on any digital input or output pin	DGND –0.3 to 3.6	V
Avinout	voltage on any analog input or output pin	AGND –0.3 to Avdd + 0.3	V
T_{stg}	storage temperature range	-40 to +125	^0C
ESD (HBM)	ESD human body mode C=100pF, R=1.5KΩ	2000	V
ESD (MM)	ESD machine mode	200	V
I_{off}	leakage current	10	uA
I_{latch}	minimum latch up current	100	mA

6.2 Operation conditions

Table 3

symbol	Parameter	value	unit
DVdd	digital supply voltage (3.3V)	+3 to +3.6	V
DVddL	digital supply voltage (1.8V)	+1.62 to +1.98	V
Avdd	analog supply voltage (3.3V)	+3 to +3.6	V
AvddL	analog supply voltage (1.8V)	+1.62 to +1.98	V
T_A	operating ambient temperature range	0 to 70	^0C
T_J	operating junction temperature range	0 to 115	^0C

6.3 DC electrical characteristics

Table 4

symbol	parameter	test condition	value	unit
V_{DI}	USB full speed differential input	| (D+) – (D-) |	0.2 (min)	V
V_{CM}	sensitivityUSB full speed differential common mode range	Included V_{DI} range	0.8 (min) 2.5 (max)	V
V_{HSSQ}	USB high speed squelch detection threshold		100 (min) 150 (max)	mV
V_{HSDSC}	USB high speed disconnect detection threshold		525 (min) 625 (max)	mV
V_{HSCM}	USB high speed data signaling common mode voltage range		-50 (min) 500 (max)	mV
V_{IH}	dttithhld high level input voltage		2.0 (min)	V
V_{IL}	low level input voltage		0.8 (max)	V
V_{OH}	high level output voltage	I_{OH} = -4 mA	2.3 (min)	V
V_{OL}	low level output voltage	I_{OL} = 4 mA	0.5 (max)	V
I_{IL}	low level input current	V_I = 0 V	RSTN pin :z - 50.0 (max) the other pins : - 3.0 (max)	μA
I_{IH}	high level input current	V_I = 3.6 V	3.0 (max)	μA
I_{DD}	input supply current	20 (max)	mA	
Isuspend	supply current in suspend	350 (max)	μA	

6.4 AC electrical characteristics

6.4.1 USB transceiver signal (full speed mode)

Table 5

symbol	parameter	test condition	min	max	unit
Tr	transition rise time for DP or DM		4	20	ns
Tf	transition fall time for DP or DM		4	20	ns
Trfm	rise / fall time matching	(Tr / Tf) * 100	90	111.11	%
Vo(crs)	signal crossover voltage		1.3	2.0	V

6.4.2 USB transceiver signal (high speed mode)

Table 6

symbol	parameter	test condition	min	max	unit
Thsr	transition rise time for DP or DM		0.5		ns
Thsf	transition fall time for DP or DM		0.5		ns

6.4.3 Operation clocks

Table 7

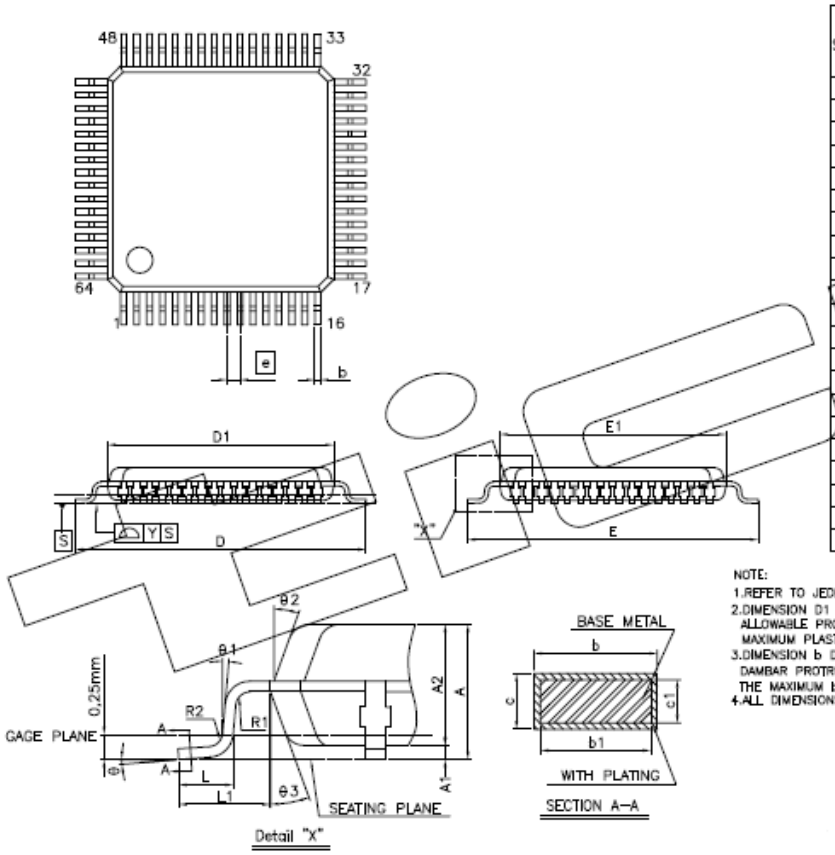
symbol	parameter	value	unit
USBCLKin	XI/XOUT crystal value	12 (typ)	MHz
	USBCLKin duty cycle	50 ± 2	%

6.5 Power consumption

Table 8

symbol	parameter	value	unit
Io_max	Max current in operation	80	mA
Is_max	Max current in suspend mode	TBD	uA

7. Packaging dimension



SYMBOL	DIMENSION (MM)			DIMENSION (MIL)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A			1.20			47
A1	0.05		0.15	2		6
A2	0.95	1.00	1.05	37	39	41
b	0.13	0.18	0.23	5	7	9
b1	0.13	0.16	0.19	5	6	8
c	0.09		0.20	4		8
c1	0.09		0.16	4		6
D	9.00 BSC			354 BSC		
D1	7.00 BSC			276 BSC		
E	9.00 BSC			354 BSC		
E1	7.00 BSC			276 BSC		
e	0.40 BSC			16 BSC		
L	0.45	0.60	0.75	18	24	30
L1	1.00 REF			39 REF		
R1	0.08			3		
R2	0.08		0.20	3		8
Y			0.075			3
θ	0°	3.5°	7°	0°	3.5°	7°
θ1	0°			0°		
θ2	11°	12°	13°	11°	12°	13°
θ3	11°	12°	13°	11°	12°	13°

NOTE:
1.REFER TO JEDEC MS-026/ABD
2.DIMENSION D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PER SIDE D1 AND E1 ARE MAXIMUM PLASTIC BODY SIZE DIMENSION INCLUDING MOLD MISMATCH.
3.DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THAN 0.08mm.
4.ALL DIMENSIONS IN MILLIMETERS.